THE NEWARK DRAINAGE SYSTEM IN KNOX, LICKING, AND NORTHERN FAIRFIELD COUNTIES.

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INTRODUCTION.

The Newark Valley was first named and described in a paper written by G. W. Tight and published about 1897 in Vol. VIII of the Bulletin of Denison University. The general features of this valley were noted and the probable outlet to the southwest was discussed by Leverett in 1902.[1] Since that time papers by various authors have appeared from time to time in the Bulletin of Denison University dealing with local changes of drainage in the vicinity of Granville, Newark, and Hanover, but little concerted effort has been made to add to the data on the Newark Valley or to map out and record the drainage of Newark age in the region lying north of Newark in Licking and Knox counties.

In his report on Knox and Licking counties, Read mentions some old filled channels in the vicinity of Mt. Vernon and Martinsburg.[2] In his early work Tight states that "the preglacial channel of North Fork probably extended into Knox County and received the head waters of Owl Creek,"[3] but later as reported and approved by Leverett he considered that a divide crossed the North Fork near Utica and that the waters north of this divide discharged into the Scioto basin through an old channel extending westward past Homer.[4] In a later paper Scheffel concludes that the drainage of the lower portions of the valleys of Raccoon Creek, Brushy Fork, and North Fork drained into the Newark Valley.[5] Much data is now available in the form of well records which did not exist at the time of the early investigations but which adds

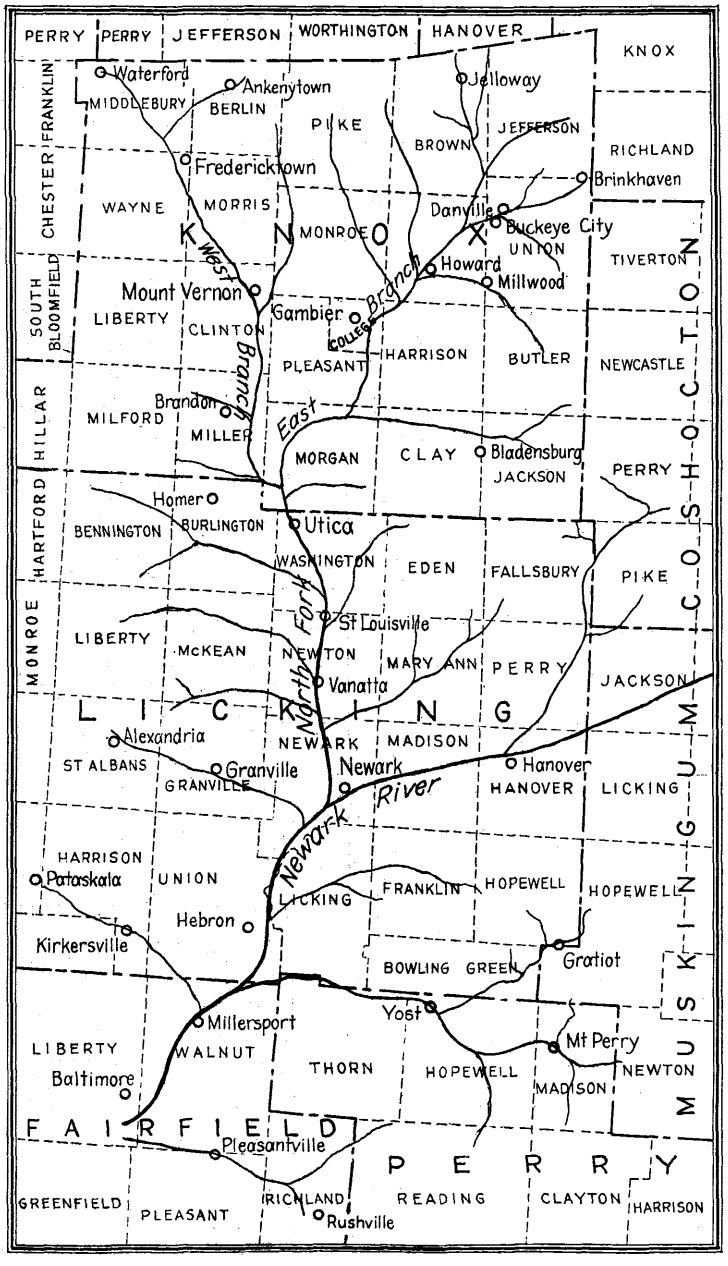
[1]Leverett, Frank, U. S. Geol. Survey, Mon. XLI (1902), p. 155.

[2]Read, M. C., Geol. Survey Ohio, Vol. III (1878), pp. 325–361.

[3]Tight, W. G., A Contribution to the Knowledge of the Preglacial Drainage of Ohio. Bull. Denison University, Vol. VIII (1897), p. 37.

[4]Leverett, Frank, U. S. Geological Survey, Mon. XLI (1902), pp. 160–161.

[5]Scheffel, E. R., Drainage Changes Near Granville, Ohio. Bull. Denison University, Vol. XIV (1908), pp. 171–172.



Map showing the location of the old Newark River and the drainage tributary to it in Knox, Licking, and northern Fairfield counties.

much to our detailed knowledge not only of the Newark Valley but of the Newark drainage system throughout eastern Licking and Knox counties. To record such data and to state the conclusions derived from its study is the purpose of this paper.

During the past thirty years many deep wells have been drilled to the Clinton sand over a broad belt extending from Lancaster, Fairfield County, northward past Newark and Granville to Mt. Vernon and also along the old valley from Newark east to Frazeysburg. The records of several hundred wells located in these areas have been secured, their locations carefully plotted on maps, and the lengths of the drive pipe noted. Where such locations occur along streams or on flat lands the well-head and bed rock elevations have been determined within narrow limits of error. Where rock gorges occur partially or completely filled with glacial drift, it is necessary in figuring valley profiles to assume that the lowest bed rock elevation in any locality represents the old valley bottom. The chief drainage lines of the old Newark system in Licking and Knox counties which have been determined in this way are shown on the accompanying map.

THE NEWARK VALLEY.

The Newark Valley extends from Trinway past Frazeysburg and Hanover to Newark where its course turns more to the southwest. East of Newark the valley is a distinct topographic feature but southwest of that town it is so choked with glacial drift that beyond Buckeye Lake its position can not be determined by surface contour. Its course, however, can be traced by well records as far as Baltimore, Liberty Township, Fairfield County. Beyond Baltimore very few wells have been drilled and therefore little data can be secured. However, the most likely course for the old channel is westward past Canal Winchester where in all probability it turns to the southwest meeting the axis of the Scioto basin a short distance north of Circleville.

Between Newark and Frazeysburg the old valley is rock bound for outcrops are present along its slopes high above present bottom flats. The filling varies in thickness from 314 feet at Newark to about 165 feet near Trinway. Many wells drilled near Black Run in the northwestern part of Jackson Township, Muskingum County, record alluvium in this valley of 200 feet or more in thickness. At the C. B. Fawcett well

located near the center of the valley about 2 miles west of Trinway, bed rock was struck at a depth of 166 feet, giving an elevation for the rock floor at this place of about 600 feet above tide. At the Amos Zartman well just south of the fairgrounds at Newark and also situated near the center of this old valley, bed rock with an elevation of 537 feet was reached at a depth of 297 feet below the surface. The distance between these two wells is about 22 miles making an average slope of the valley floor to the southwest of about 34 inches per mile.

From the west edge of Newark the old channel is directed a little west of south passing a short distance east of Hebron to the north shore of Buckeye Lake. Here the valley turns to the west and extends beneath the western end of the lake as far as Millersport where it again turns to the south and passes about a mile northwest of Thurston to a point approximately one mile south of Baltimore. The maximum thickness of the drift in this part of the valley is about 350 feet. In the region lying immediately north of Buckeye Lake wells penetrate drift ranging from 65 to 345 feet in depth. The lowest point of which we have record in the old channel in this vicinity was reached in the Cliff Sturgeon No. 3 well located on the north shore of the lake about one mile southwest of the electric railway terminal. The drift here has a thickness of 344 feet and the elevation of bed rock is about 540 feet.

Southwest of the west end of Buckeye Lake glacial drift in excess of 300 feet in thickness is of common occurrence. At the Marie Fry No. 1 well in the south part of Section 27, Walnut Township, the drift measures 316 feet, while the elevation of bed rock is about 585 feet. The record of the Thomas Bryson No. 1 well in Section 4, Walnut Township, shows 388 feet of drift with bed rock at a height of 550 feet. Deep wells drilled at Thurston and Baltimore penetrate drift exceeding 300 feet in thickness,and reach bed rock at elevations of approximately 550 feet. Records now available indicate that the lowest elevation of bed rock in the old valley occurs in the northwestern part of Section 30, Liberty Township, where in the Adam Wagner No. 1 well the drift has a thickness of 339 feet and the rock floor has a height of about 521 feet above sea level which is about 17 feet lower than at the Zartman well at Newark. The distance between these two wells measured along the channel defined by well records is

about 17.7 miles. The average fall to the southwest is therefore about 10.8 inches per mile for that part of the valley between Newark and Baltimore. If this gradient were projected along the most probable course past Canal Winchester in the direction of Ashville, the elevation of the channel at the latter place would be about 500 feet. That thick deposits of drift occur near Ashville is evidenced by the record of the L. C. O'Daffer well drilled about one mile northwest of town where bed rock having an elevation of 535 feet was reached at a depth of about 167 feet.

VALLEYS TRIBUTARY TO THE NEWARK CHANNEL.

Southwest of Newark the upper surface of bed rock rises rather abruptly along the east side of the old Newark channel for it reaches heights of 150 to 200 feet in the horizontal distance of a mile. The regularity of the slope is broken at a few places by tributary channels which received waters from the region lying to the eastward. One of the largest of these tributaries had its head waters in the northwestern corner of Reading Township, Perry County. It extended to the southwest across northern Richland Township to a point a little south of Shakes Run School where it turned to the northwest, passed through Pleasantville, and united with the Newark Valley south of Baltimore. It was joined from the south by a tributary valley which headed a short distance southwest of Rushville, flowed northwest, and met the main tributary in the northwestern corner of Section 20, Richland Township. The position of these tributary valleys is marked by an excessive thickness of drift. In the central part of Section 10, Richland Township, the drift has a thickness of 195 feet. Wells drilled near Shakes Run School show 240 and 273 feet of drift while at Pleasantville the drift reaches a thickness of 322 feet.

A second and larger tributary entered the Newark channel at Buckeye Lake. Its head waters received much of the drainage of Madison and eastern Hopewell townships, Muskingum County, and of southern Hopewell Township, Licking County. The course of this channel is located along the site of the present valley of Jonathan Creek as far as the Perry-Muskingum County line where a col formerly existed.[6] Secondary tributaries extended along the sites of what are now

[6]Davis, H. J., Modifications in the Jonathan Creek Drainage Basin. Bull. Denison University, Vol. XI (1899), pp. 164–175.

Painters Run, Turkey Run, and Valley Run in Madison and Hopewell townships. Little data on the thickness of the drift can be secured in this region. However, well No. 1 situated on the Fred S. Mechling property at Yost in Section 5, Hopewell Township, Perry County, and located near the center of the old channel, penetrated 207 feet of drift before reaching bed rock. At the John Yost No. 1 well near Thornville Station the thickness of the drift is about 290 feet and the elevation of bed rock is about 615 feet above tide. The course of the old valley apparently paralleled the southern shore of the eastern half of Buckeye Lake, meeting the Newark channel near the western end of the lake.

A third valley of less extent is followed closely by the present valleys of Swamp Run and Claylick Creek from eastern Franklin Township, Licking County, as far west as Fleatown where the valley took a southwestern direction joining the axial channel a short distance east of Hebron. Northeast of Fleatown bed rock occurs above the level of the present drainage which in a part of its course flows on a thick deposit of glacial drift. About 112 feet of such material was penetrated before reaching bed rock at the Sina Swisher No. 1 well located about 2 miles above Fleatown, and 187 feet was recorded at the Davis No. 1 well located one-half mile west of Fleatown.

Valleys from the west tributary to that part of the Newark channel located southwest of Newark are not clearly defined as the glacial drift deposits are generally thick and as few deep wells have been drilled. The upper surface of bed rock apparently rises to the northwest from Baltimore, for in the northwestern quarter of Section 12, Liberty Township, only 54 feet of drift were recorded in well No. 1 on the F. P. Miller farm. As the well-head elevation is about 950 feet, the upper surface of bed rock occurs here at an elevation of about 896 feet or some 370 feet above the level of the Newark channel to the east. A large tributary apparently headed in the direction of Pataskala, flowed southeast past Kirkersville, and entered the axial channel near the western end of Buckeye Lake. A deep well drilled along this old channel about 2 miles northeast of Etna and near the southern edge of Harrison Township penetrated 320 feet of drift and struck bed rock at an elevation of about 645 feet. A second deep well located about 1¼ miles east of Etna reached rock at a depth of 183 feet or at an elevation of about 850 feet. The drift is generally

thick in the northwestern part of Union Township, for wells show depths ranging from 230 to 350 feet. Bed rock elevations in this part of the township vary from 620 to 665 feet. The rock surface rises to the north, however, for it reaches heighths of 800 feet or more in the northwestern part of Union Township.

RACCOON VALLEY.

During the Newark stage a deep channel was cut along the site of the present valley of Raccoon Creek at least as far west as Alexandria.[7] The depth of the valley filling is about 220 feet below stream level at Alexandria and about 250 feet at Granville. West of Alexandria the old channel is not clearly defined as well data is lacking. South of Raccoon Creek rock outcrops occur along Moots Run in St. Albans Township, and the upper surface of bed rock extends to or above the level of Raccoon Creek in southwestern Granville Township. Wells drilled along the north slope of the valley penetrated drift ranging in thickness from 45 to 160 feet. At the Andrew Board No. 1 well located one mile northeast of Alexandria bed rock having an elevation of about 1000 feet was reached at a depth of about 40 feet. Bed rock with an elevation of about 960 feet was encountered at a depth of about 160 feet at the Tally No. 1 well situated along the road three-fourths of a mile southeast of St. Albans Church. A third well drilled on the Chas. Guckert property two miles northeast of Granville showed 46 feet of drift with bed rock encountered at an elevation of about 1030 feet. A fourth well on the William Howe farm north of Granville penetrated 63 feet of drift before reaching solid rock which has an elevation at this place of about 970 feet.

NORTH FORK AND ITS TRIBUTARY VALLEYS.

The axial drainage of the Newark system was joined at Newark by a large tributary from the north which had its head waters in northern Knox County. The main channel of this tributary followed closely the site of the present North Fork of the Licking River from the southwestern corner of Morgan Township, Knox County, to its mouth at Newark. For purposes of convenience in this description it will be known as

[7]Scheffel, E. R., Significance of Drainage Changes Near Granville, Ohio. Bull. Denison University, Vol. XIV (1908), pp. 157–174.

the North Fork of the Newark Valley. In Morgan Township the North Fork was formed by the union of two branches, an East Branch which had its head waters in Pike, Brown, and Jefferson townships, Knox County, and a West Branch which headed in Berlin and Middlebury townships and probably received waters from the east-central part of Morrow County.

The North Fork of the Licking River from Morgan Township to its mouth flows on glacial material which varies from 300 to 360 feet in thickness. This excessive thickness of drift represents the amount of filling in the old channel which was much narrower than the present valley. Wells drilled near the margins of the valley flats sometimes show comparatively little drift, while wells more centrally located reach bed rock at much greater depths. Bed rock in the Newark channel near the mouth of North Fork lies some 300 feet below the surface and has an elevation of about 537 feet. At the Frank A. Dusk No. 1 well located west of the center of the valley in southern Newton Township bed rock with an elevation of about 680 feet was reached at a depth of 231 feet. The record of the McKinney well situated near the eastern edge of the valley three-eighths of a mile southeast of Vanatta, shows that 110 feet of drift was penetrated before reaching bed rock which occurs at this place at an elevation of about 730 feet. A third well drilled near the center of the old channel 1½ miles south of St. Louisville reached rock at a depth of 276 feet. The elevation of the upper surface of solid rock at this well is about 605 feet or about 68 feet above the level of the channel at Newark. The record of another well located on the William Weitham farm, a half of a mile east of the mouth of Lake Fork, shows 336 feet of drift with bed rock at a height of 614 feet. At the junction of East Branch and West Branch the upper surface of bed rock occurs at an elevation of about 655 feet, which is 118 feet higher than the level of the old channel at Newark. Based on these figures the average slope of the old channel of North Fork was slightly more than 7 feet per mile to the south.

Leverett examined the valley of North Fork and found low rock hills in the midst of lowlands about 3 miles south of Utica. He concluded therefore, that a divide formerly existed at this place which barred a southward course for the drainage of the region lying to the north. In accordance with Tight's opinion Leverett concluded that the discharge was westward

to the Scioto basin past Homer.[8] The data derived from well logs is not in accordance with Leverett's interpretation. Wells drilled on the present valley flats about 2½ miles south of Utica and therefore a little north of the proposed divide, show the presence of a deep channel as much as 336 feet below the general level of the lowlands. Here the elevation of bed rock, which is about 614 feet, is only about 60 feet higher than it is at Newark and it is lower than at any place in the old channel farther north. These facts point to a southern direction of discharge past Utica to Newark.

West of North Fork many well records in Bennington, Burlington, McKean, Liberty, Granville, and St. Albans townships show that bed rock occurs on the uplands at elevations ranging from 950 to 1150 feet, while east of the valley in Newark, Newton, Washington, and Morgan townships the upper surface of bed rock rises to elevations ranging from 750 to 1050 feet.

Three tributaries of some size entered the North Fork from the east. The first and most northern one of the three had its head waters in southeastern Morgan Township and flowed in a westerly direction past White Oak School. A well drilled along this channel on the Rachel Bell farm one-half mile west of White Oak School struck bed rock at an elevation of about 790 feet after penetrating 212 feet of drift.

A second tributary channel entered the North Fork near St. Louisville. Its valley extended to the northeast through eastern Washington Township along a course now followed closely by a southwestern branch of Rocky Fork. A boring at the Redbrush School penetrated 335 feet of drift before reaching solid rock, while five-eighths of a mile farther west a well having about the same elevation reached rock at a depth of about 178 feet. At the M. J. McClelland No. 1 well located along this old channel about 1½ miles north of Redbrush School rock was reached at a depth of about 280 feet. As the casing-head elevation is about 1025 feet, bed rock at this well has an elevation of about 745 feet. One-half mile northeast of the McClelland well, a test on the M. H. Thrapp farm showed 245 feet of drift with bed rock at an elevation of about 765 feet. To the northwest and southeast of the McClelland and Thrapp wells borings show that bed rock rises to elevations

[8]Leverett, Frank, U. S. Geol. Survey, Mon. XLI (1902), p. 161.

of 1000 feet or more. From the Thrapp well the old channel extends into northwestern Eden Township.

The third tributary from the east entered North Fork in the northern part of Newark Township. It extended to the northeast past Newton Chapel, Wilkins Run, and Hickmon, and had its headwaters in northwestern Perry, southwestern Fallsbury, and eastern Eden townships. Rocky Fork now receives waters from much of the area which formerly drained through this tributary channel. Few wells have been drilled along the course of this old valley and no data on the thickness of the drift is at hand.

Many tributaries entered the North Fork of the Newark Valley from the west but only three are sufficiently well developed to merit much consideration. Two of these tributaries can be traced west to a line extending due north from Alexandria, St. Albans Township. West of this line their course is in doubt as no well data can be secured. Beginning at the north the first large tributary enters the channel of North Fork about one mile north of St. Louisville. This channel was formed about one mile west of Pattons Corners by the union of two tributaries, one from the northwest and the other from the southwest. Southeast of Pattons Corners the course of the old valley is parallel to Lake Fork but lies a little to the south of it. The drift along the course of this valley ranges in thickness from 250 to 400 feet and the elevation of bed rock varies from 615 feet at its mouth to 710 feet in central Bennington Township. On the divide areas to the north and south of this channel the drift rarely exceeds 150 feet in thickness with bed rock occurring at elevations ranging from 950 to 1100 feet. At the D. Myers No. 1 well located in the valley of North Branch about one mile south of the Licking School in Bennington Township, the upper surface of bed rock with an elevation of 715 feet, was reached at a depth of 395 feet. A well drilled along the South Branch about three-fourths of a mile southwest of Beech Knob School penetrated 381 feet of drift before reaching bed rock which at this place has an elevation of about 710 feet. In the region of Fairview School between these branches solid rock occurs at elevations exceeding 900 feet. A half of a mile southeast of Pattons Corners a well located along the main channel of this tributary penetrated 357 feet of drift striking bed rock at about 640 feet above sea level.

The second tributary from the west apparently extended from the central part of Liberty Township to the channel of North Fork near the present site of Vanatta. The Clear Fork of the Licking River follows very closely the course of this old valley. Well records show the elevation of bed rock near Hancock School to be about 920 feet or approximately 300 feet below the surface. Within one mile north or south of this location the upper surface of bed rock rises over 100 feet. One-fourth of a mile east of Brooks Corners a well penetrated 272 feet of drift reaching solid rock at an elevation of about 860 feet. Few wells have been drilled along the channel east of Highwater. However, a boring three-fourths of a mile southeast of Blackhawk School on the south side of the present valley passed through 140 feet of drift, reaching bed rock at an elevation of 860 feet. On the highlands to the north and south of the valley the drift is generally much thinner with bed rock occurring at elevations of 1050 to 1150 feet. A well along the south side of the valley in western Newton Township reached bed rock at an elevation of about 825 feet.

The third and smallest tributary from the west apparently headed in northwestern Granville and southwestern McKean townships and took a course to the North Fork along the site of the present valley of Brushy Fork. A well drilled on the Alva Hamilton farm near the headwaters of this tributary in northwestern Granville Township, showed 245 feet of drift overlying rock which stands at an elevation of about 775 feet. A mile east of this location and on the south side of the valley bed rock has an elevation of about 860 feet, while one mile southeast it rises to 1035 feet, and one mile west it has an elevation of about 960 feet. From the bed of this old channel the upper surface of bed rock rises to the north reaching elevations of 1000 to 1200 feet in McKean Township and 1000 feet or more in eastern Granville Township.

EAST BRANCH OF NORTH FORK AND ITS TRIBUTARIES.

From its junction with the West Branch near the mouth of Sycamore Run in Morgan Township, Knox County, the old channel of East Branch can be traced by well borings in a northeasterly direction to the headwaters of Big Run. Here the channel took a more northern direction to the Kokosing Valley along a course lying slightly west of the present valley of Big Run. From the mouth of Big Run the channel of

East Branch extended along the site of the Kokosing Valley to Howard where it continued in a northeasterly direction through the valleys of Jelloway Creek and Dowd Creek to the present Mohican Valley in eastern Jefferson Township. Excessive thicknesses of drift are recorded in the records of wells drilled along this channel. Near the junction of East Branch and West Branch in Morgan Township, the drift has a thickness of about 300 feet while the bed rock elevation is about 655 feet. Surface materials of similar thickness are found along the channel in Morgan and eastern Pleasant townships. The E. L. McMahon No. 1 well situated along Big Run in the northeastern corner of Pleasant Township is probably centrally located with respect to the old channel as it penetrated 228 feet of drift before reaching bed rock at an elevation of about 720 feet. The rock slopes rise abruptly from this old channel, for the upper surface of bed rock stands at elevations of 1000 feet or more in the northwestern corner and the north central part of Morgan Township and also over much of central and western Pleasant Township.

The channel of East Branch apparently extended along the site of the present valley of the Kokosing River from Howard to the mouth of Big Run. Little well data on the depth to bed rock is available in this part of the valley. That it is deeply filled with drift is indicated however, by the record of the Kidruff No. 1 well located at the northern edge of the valley and at the southern edge of Howard Township where bed rock was reached at a depth of 129 feet.

Along the course of Jelloway Creek and Dowd Creek northeast of Howard valley filling in excess of 100 feet in thickness is present, while on the bordering uplands the surficial deposits vary from 25 to 60 feet. At the James A. Greer No. 1 well located near the west edge of the valley in the northeastern corner of Howard Township, rock with an elevation of about 840 feet was encountered at a depth of 121 feet. At the Rila Rabjohn No. 2 well situated in the valley just north of Dowd Run in the southwestern corner of Section 8, Jefferson Township, rock was reached at a depth of 117 feet or at an elevation of about 900 feet. The deep channel is believed to continue northeast of the Rabjohn well past the Pleasant View School at least as far as the Mohican River, but well data along this part of its course is not at hand. The average slope of the valley of East Branch from the north edge of Howard Town-

ship to the north edge of Morgan Township is about 13½ feet per mile. From the latter point where a large tributary enters from the east to its junction with the West Branch, the valley slopes to the southwest at a rate slighlty in excess of 5 feet per mile.

Valleys tributary to the East Branch were numerous but data on the amount of filling is somewhat meager. The largest tributary entered East Branch from the east through northeastern Morgan Township and northern Clay Township. It received the waters of Harrods Run and had its head waters in the area now drained by Wakatomika Creek east of Bladensburg. A well drilled in this channel on the E. Rinehart property near the eastern edge of Morgan Township penetrated 318 feet of drift reaching bed rock at an elevation of about 680 feet.

A tributary entered East Branch from the northwest near the present mouth of Big Run. This tributary received the waters of Wolf Run and flowed in a southeasterly direction along the present course of the Kokosing valley to the channel of East Branch. A well drilled on the river bank just west of Kenyon College penetrated 40 feet of drift before reaching bed rock. Two miles west of Gambier the Kokosing River flows in a rock-bound channel.

A second tributary from the northwest had its head waters in central Pike Township and followed a course to the southeast along the valleys of Little Schenck Creek and Schenck Creek, joining East Branch in the southwestern part of Howard Township. No well data on the thickness of valley filling is at hand. A third tributary from the northwest followed the site of Little Jelloway Creek from eastern Pike Township, meeting the East Branch near the present mouth of Schenck Creek. The lower part of this tributary valley contains an excessive thickness of glacial material as shown by the record of the N. H. White No. 1 well located in the old channel one mile east of Fairview School where 184 feet of drift is found. A second well is located near the present stream level on the T. J. Porter farm, five-eighths of a mile south of the north boundary of Howard Township, passed through 83 feet of drift material before reaching bed rock. On the uplands both east and west of this location well records show less than 60 feet of glacial material.

In the southeastern part of Brown Township the East Branch was joined by a tributary which headed along its

northern boundary and flowed southward along the site of Jelloway Creek, but in a channel much deeper than the present valley. It was joined by a tributary from the west which had its head waters near Cottage Hill School, and also by a tributary from the northeast which flowed along the site of Hadley Valley. Definite data on the thickness of the drift is likewise meager along the course of these tributary channels. Leveritt reports that flowing water wells 40 feet in depth have been secured in the drift in the valley at Jelloway.[9] Very little glacial drift is present on the uplands in this vicinity.

A drift filled channel extends from Brinkhaven southwest past Danville, meeting the present valley of Jelloway Creek in the eastern part of Howard Township. This channel was evidently a tributary to the East Branch of the North Fork of the Newark Valley. Leveritt cites a well drilled to a depth of 136 feet at Danville without striking bed rock.[10] As the major part of the town has an elevation ranging from 1,000 to 1,040 feet, bed rock at this place can not be much above 900 feet elevation and is probably somewhat below this level. Oil wells drilled about one mile northwest of Danville struck solid rock at or above elevations of 1,050 feet. The topography suggests that this deep channel was joined at Danville by two tributaries, one from the northeast and the other from the southeast. The first of these tributaries had its head waters near Turkey Ridge School in Jefferson Township and followed a course along the site of the East Branch of Jelloway Creek. A well drilled on the Louis A. Lower farm and located on this channel in the central part of Section 24, reached rock at a depth of 82 feet, while on the hills to the northwest and southeast bed rock lies close to the surface. The second tributary apparently headed in the direction of Flat Ridge School and extended northwest past Buckeye City.

The East Branch was joined below Howard by a tributary from the east which had its head waters in Brush Run in Butler Township. From Zuck the course of this tributary channel extended to the northwest along the valley of the Kokosing River for a distance of about one-half mile. From exposures along the valley at this place there is evidence that a channel now filled with drift formerly extended to the northwest across the neck of land formed by the broad loop to the south of the

[9]Leverett, Frank, U. S. Geol. Survey, Mon. XLI (1902), p. 406.
[10]Idem., p. 401.

present gorge of the Kokosing. The old channel entered the present valley a short distance northwest of the plant of the Millwood Stone Co. and continued along the site of the present channel to the East Branch below Howard. No well data on the thickness of the drift in this tributary valley has been secured. The foregoing conclusions are based on the general thickness of fill in the East Branch near the mouth of the tributary, the direction of flow of Brush Run, and the results of field observations along the gorge of the Kokosing River.

WEST BRANCH OF NORTH FORK AND ITS TRIBUTARIES.

The valley of West Branch of the North Fork of the Newark drainage can be traced by well records with some degree of accuracy from its junction with the East Branch in Morgan Township through eastern Miller and Clinton townships to Mt. Vernon. From here it is believed that the main channel extended to the northwest, passing through the western part of Mt. Vernon in the general direction of the Kokosing River and entered Middlebury Township a short distance west of Fredericktown.

South of Mt. Vernon the valley of the West Branch is filled with drift ranging in thickness at various localities from 260 to 350 feet. The record of the J. W. Campbell well, located in this valley near the northeastern corner of Licking County, shows 329 feet of drift with the upper surface of bed rock at an elevation of about 656 feet. In the Philo Higgins No. 1 well, situated about 1½ miles northwest of the Campbell well, the drift has a thickness of 349 feet and bed rock occurs at an elevation of about 680 feet. The drift has a recorded thickness of 285 feet at the C. A. Lefever No. 1 well, located in this old valley in the southeastern corner of Clinton Township. Near Cherry Hall School the lowest part of the channel is marked by 265 feet of drift lying on bed rock which has an elevation of 745 feet as recorded in the record of Well No. 1 on the W. J. Workman property. On both sides of the valley the surface of bed rock rises rather abruptly to elevations of 900 feet or more on the west and 1,000 feet or more on the east. The average slope of West Branch from Mt. Vernon to its junction with the East Branch is on an average about 11 feet per mile to the south.

Very little drilling for oil or gas has occurred within recent years along the probable course of West Branch northwest of

Mt. Vernon. Leverett reports that a well drilled near the city waterworks and therefore in the old channel of West Branch, penetrated 224 feet of drift before reaching bed rock.[11] As the well head elevation is about 900 feet, bed rock has an elevation of about 766 feet. Rock outcrops occur in the east edge of Fredericktown, but in the western part of town wells obtain water from the drift at depths of about 40 feet. On the hills east of Fredericktown the drift sheet is generally thin. Very little data can be secured relative to the thickness of the drift north of Fredericktown in Middlebury Township. The topography suggests, however, that one channel probably extended to the northwest in the direction of Waterford and a tributary channel to the northeast past Ankertown. A well drilled about one-half mile southeast of Caywood School, Middlebury Township, and near the channel first mentioned, penetrated about 150 feet of drift before reaching bed rock.

The West Branch was joined at Mt. Vernon by a large tributary which entered from the north. This tributary had its head waters in western Pike and eastern Berlin townships and flowed south through the upper part of the valley of Schenck Creek and continued to the south along the site of the valley of Center Run. Thick deposits of glacial material occur along this old valley. About one-half mile southwest of Valley Grove School a well drilled to the Clinton sand near the center of the channel penetrated 226 feet of drift, reaching bed rock at an elevation of about 1,080 feet. Both east and west of this well the upper surface of bed rock rises to heights of 1,000 feet or more above tide or over 150 feet above the bottom of the old channel.

South of Mt. Vernon two tributaries joined West Branch from the west. The first and smaller one entered Miller Township about one mile south of the north boundary and extended from this place in a southeasterly direction past Brandon, joining the channel of West Branch about three-fourths of a mile southwest of Lafayette School. Its course is marked by excessive thicknesses of drift and a comparatively low elevation of the upper surface of bed rock. At the Splinterville School the elevation of the upper surface of bed rock is about 975 feet. At the Miller heirs No. 1 well, one mile due north of the Splinterville School, the elevation of rock is about 975 feet and five-eighths of a mile north of the Miller well it is

[11] Idem., p. 408.

1,040 feet. The Ganet Harris No. 1 well, located along the channel of this tributary five-eighths of a mile northwest of Brandon, showed 260 feet of drift with bed rock at a height of 840 feet above sea level. North and south of the Harris well rock rises to elevations of over 1,000 feet.

The second tributary from the west, which apparently was much the larger of the two, entered the west edge of Miller Township west of Oppossum Street School and followed a course a little south of east past the Vance School. As the slope of this valley to the southeast is small in Miller Township in comparison with other tributaries of this system, it is probable that the valley had its head waters some distance to the west, possibly beyond Blendon Township. A well drilled in this old channel on the Levi Thompson farm, west of Oppossum Street School in Miller Township, penetrated 360 feet of drift before reaching bed rock. A second well near Vance School passed through 324 feet of drift.

The Newark Valley was joined at Hanover by a large tributary from the northeast which apparently had its head waters in Perry Township, Coshocton County, and in Jackson Township, Knox County, and extended along the sites of the Brushy Fork and Wakatomika valleys in Perry and Fallsbury townships, Licking County, and the Winding Fork Valley in Pike and Perry townships, Coshocton County. The topography suggests that a tributary entered this channel from the north along the site of Jug Run in Jackson Township, Knox County, and in Fallsbury Township, Licking County. A second tributary entered from the east along the site of Five-mile Creek in Pike Township, and Wakatomika Creek in northwestern Jackson Township. The old valley floors are now buried beneath thick deposits of glacial outwash. At the Ashcroft well, situated on the side of the valley in Section 21, Fallsbury Township, the drill penetrated 58 feet of drift, reaching bed rock at an elevation of about 742 feet. Records of wells drilled in the old valley at Perryton show alluvial material ranging in thickness from 60 to 160 feet. At the J. E. Seward No. 3 well, located about four-fifths of a mile east of town, the valley filling has a depth of 158 feet, bed rock being reached at an elevation of about 630 feet. No records of the thickness of the drift has been secured southwest of Perryton. Unconsolidated materials also occur in excessive thickness along the eastern tributary in northwestern Jackson Township.

A quarter of a mile west of the Patterson Bridge across Wakatomika Creek, the drill penetrated 99 feet of unconsolidated material before reaching bed rock, while a quarter of a mile southeast of this bridge the record of a well drilled near the center of the present valley shows 40 feet of unconsolidated materials. Wells drilled near Ashcroft Ford also show a great thickness of drift.

SUMMARY AND CONCLUSIONS.

During the Newark stage the drainage of Knox County and the north central part of Licking County discharged to the south into the Newark River through a channel which in Licking County followed closely the site of present North Fork of the Licking River. This channel and its numerous tributaries contain drift deposits of great but varying thickness. Data derived from well borings show no evidence of a divide near Utica, as proposed by Leverett, which would block a southern course for the drainage of Knox County during Newark time.

The divide which marked the rim of the basin of North Fork and its tributaries has not been definitely determined on the west, but it probably passed through western Licking and eastern Morrow counties. On the north it is marked by the highlands which extend across the northern edge of Knox and the southern part of Richland and Ashland Counties, while on the northeast it is represented by Kaylor Ridge in western Knox County and by the high hills of its southern continuation in northwestern Coshocton County. It is believed that this divide crossed the Kokosing Valley near the west edge of Coshocton County.

Through numerous tributary channels now deeply filled with drift the Newark River southwest of Newark received the drainage of southern Licking, northwestern Perry, and northern Fairfield counties. Beyond Baltimore, Fairfield County, the exact location of the Newark channel has not been traced by well borings.